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DEVELOPMENT OF CORE SKILLS ASSESSMENT FRAMEWORK FOR TECHNICAL STUDENTS

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Abstract. Core skills are common, indispensable skills for anyone who wants to participate in learning and working in the twenty-first century. It is necessary to research and develop the core skills of engineering students to contribute to the improvement of the labor quality of the country. Research on the core skills of engineering students has not shown the specific skills of engineering students has not given a specific scale to evaluate those core skills. The core skills assessment framework is developed based on determining the structure and scale of skills. Based on the assessment framework, teachers can appropriately design the core skills development process for students. This article mainly focuses on research results that will be foundations for developing an assessment framework for the three core skills of engineering students including: technical communication skills, creative problem-solving skills, and technical system thinking skills. These are essential skills that are closely coordinated with the specialized skills of engineering students.

Keywords*:* Core skills, core skills assessment framework, technical communication skills, creative problem-solving skills, technical system thinking skills.

1. Introduction

The development of technology and science along with achievements in industry production becomes variety and delicately put the future engineers in a complicated context with many requirements. Specificity of engineering learning activities towards the engineering functions occupation, therefore, the students learning activities related to vehicle, machines, equipments, systems. Nowadays trend requires technical students to participate in the entire product life cycle, process, and systems from simple to complex. Engineers not only give ideas, design, and manufacture products but also give directions and product sales therefore they need to exchange ideas, drawing data in groups. A good engineer practices creativity and personal responsibility. Technical learning activities have the following characteristics: (1) Learning activities associated with practice and solving practical professional situations; (2) Learning activities require self-reliance, self-study, self-research, innovative and creative thinking; (3) Learning activities are associated with interdisciplinary technical situations. The demands of high-pressure learning process, engineering students must prepare for professional skills and core skills. These two skill groups must closely coordinate and fit together in the entire learning process of engineering students. Core skills such as technical communication skills, creative problem-solving skills and

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systems thinking skills must be formed and developed throughout the training process. Elisabeth Dunne et al (2006) argue that *core skills are the key to personal development* [1, p.511]. Michael Carr and Eabhnat Ni Fhloinn (2009) said that *core skills must become compulsory skills for students throughout the training process* [2, p.20]. The British document "Skills for care" provides guidance for developing practical skills and emphasizes *core skills that help individuals apply problem-solving in everyday work, so it is important to attach core skills core into the workplace. It can be said that developing core skills is the preparation for engineers in future jobs.* The Scottish Accreditation Authority (SQA) states that "*The importance of core skills is widely recognized in education and the professional world. Lifelong learning based on people's core skills is essential for individuals to fulfill their individual needs and meet the needs of society. Individuals who can analyze and solve problems, communicate well, use information technology, and work with others effectively*" [3, p.1]. The core skills of engineering students in Vietnam are researched in limited. The problem is to find the best way to develop these skills for engineering students to meet the requirements of employers after graduation.

Each core skill has component skills and specific indicators. Based on that, an assessment framework for each core skill was developed. Building the core skill structure is to define its component skill. Based on the structure and scale of these skills, the trainer can find a way to develop these skills appropriately or appropriate measures of impact. Therefore, it is necessary to study and develop a framework for assessing core skills. The article focuses on the following main issues: building a structure of three core skills of engineering students, including: technical communication skills, creative problem-solving skills, and systematic thinking skills. technical system; building a scale and evaluation criteria for these three core skills. Research results are an important basis for proposing measures to develop core skills for engineering students.

2. Content

2.1. Concepts

2.1.1. Skill concept

The concept of skills was interested in early, based on the analysis and synthesis of skills concepts of V.A. Kruchetsky (1981) [4], A.V. Petrovski [5], Tran Trong Thuy [6], Dang Thanh Hung [7], have pointed out four characteristics of skills, including: (1) The skill of showing the technical side of a certain operation or action; (2) Skills have an integral component of knowledge, the theoretical side of performing the action and previous experience; (3) Skills must be measured with specific criteria of accuracy, proficiency, flexibility, and coordination in each operation; (4) Skills are associated with psychological attributes such as motivation, will, and affection, not merely manipulations. From these characteristics, the study unifies the concept of skills as follows: *Skill is a specific action and intellectual action that is performed skillfully and skillfully in specific conditions to achieve a goal.*

2.1.2. Core skills of technical student concept

The concept of core skills has been interested since the early years of the twentieth century. Carole Myers (1992) argued that *core skills are skills that are universally applicable to many career fields* [8]. Roy Canning (2006) pointed out that *core skills and key skills are interchangeable or interchangeable* [9]. Zalizan (2007) defines *core skills as general skills necessary for a person to develop to their full potential in the study and in the workplace* [10]. Phan Van Nhan et al (2016) said that "*Core skills are skills of general and basic nature that any employee must have in his or her performance capacity. Core skills focus on the ability to apply knowledge, skills, and techniques in an integrated manner in real work situations*" [11, 74]. From the above points of view, the concept of core skills is defined with three issues: (1) Common and indispensable skills of employees; (2) Skills applied to study and occupation; (3) Show human potential. From these characteristics, the concept of core skills is stated by us as follows: *Core skills are skills with general properties including specific actions and intellectual actions that everyone must have, helping to solve diverse situations in learning and professional practice effectively*.

According to Sally A. Male (2010), general skills (core skills) of engineers are related to social context and technical environment, it is more useful to integrate technical skills and general skills instead of separating them into two groups [12]. In 2006, Marks pointed out that increasing employability requires a holistic approach that integrates knowledge, work experience, and technical and interactive skill development [13]. Integrating the concepts of "Core Skills" and "Technical Skills" will model respect for both aspects of technical competence: general skills and specific technical skills, overcoming the situation. relatively low level of general skills in engineering education. Thus, the term "Technical Core Skills" will integrate general skills and technical skills to reflect the diverse and flexible application of skill groups in engineering activities. Technical core skills are necessary skills of engineering students that are specific to the engineering profession.

On this basis, we introduce the concept of "core skills of engineering students" as *"core skills of engineering students are common skills that any engineering student must also have, closely coordinate with professional skills to help students solve technical problems and achieve learning goals."*

2.2. Establishments identified core skills of students in engineering sector

2.2.1. Features of the engineering sector

Author Paul Savory outlines the principles of the engineering field with a diverse network of specialties involving mathematics, physics, and chemistry, and focuses on the production and supply chain through service and production. a combination of technical skills, people skills, and the design, analysis, construction, and management of systems [14]. According to Saeed Moaveni (2010), the characteristics of the engineering profession include: (1) First, the engineering profession solves problems based on the fundamental knowledge of physics, chemistry, and mathematics to design, develop, testing and producing products and services; (2) Second, the technical profession requires learners to have the ability to: solve complex and diverse problems, be analytical and creative, lifelong learning, good communication, people and work management. job, proficient in using computers, able to work under pressure, and willing to be creative [15]. Thus, the characteristics of the engineering industry are reflected in four issues:

- Is a discipline that solves technical problems for human life based on basic knowledge of mathematics, chemistry, physic, and the main tool is computers.

- Is industry-oriented towards the design and production of products and services based on human-to-human and human-to-machine interaction.

- High-pressure working environment, continuous creativity, and innovation.

- It is an industry that requires engineers to meet many criteria of professional skills.

2.2.2. Characteristics of learning activities of engineering students

Engineering students are undergraduate students of disciplines related to vehicles, machines, equipment, systems, and materials for human activity. The current trend requires engineering students to participate in the entire life cycle of products, processes, and systems from simple to complex. They not only form ideas, design, and manufacture products, build processes, operating systems, but also play the role of guidance, leadership, and product sales. To do this, they often work in groups, exchanging thoughts, ideas, drawing data, detailed design. A good engineer must always practice creativity and personal responsibility [16]. According to Nguyen Van Tuan

(2010), technical problems have two basic characteristics, including: (1) The problem does not have enough data, the requirements are often generalized and can have many answers, need to be solved; (2) The problem has a very close relationship between intellectual action and practical action, practical experience. The closer the combination of theory and practice, the more reliable and accurate the results [17]. The learning activities of engineering students have the following characteristics: 1/Learning activities associated with technical content; 2/Learning activities associated with practice and solving practical professional situations; 3/Learning activities require self-reliance, self-study, self-research, innovative and creative thinking; 4/Learning activities associated with interdisciplinary technical situations.

2.2.3. Outcomes of training programs and the labor market's requirement

In the document "Rethinking Engineering Education the CDIO approach" by Edward F. Crawley et al. (2007) according to CDIO output standards, engineering students need to achieve very specific knowledge, skill, and attitude goals. In terms of skills engineering students must achieve: 1/Technical reasoning and problem-solving skills; 2/Skills of experimentation and knowledge discovery; 3/Systems thinking skills; 4/Teamwork skills; 5/Communication skills. [16, p.209-301]

In summary, from the above establishments which determine the core skills of engineering students, we believe that the skills selected as core skills must satisfy the requirements of learning in a learning environment and develop the technical engineer's future career skills. We determine that the skills selected as core skills must be the skills that engineering students use regularly and continuously and combine with professional skills to help students implement learning tasks, solve technical problems, and meet the output standards. Therefore, we offer three core skills that are distinctly specific to engineering students, including:

- Technical communication skills
- Technical systems thinking skills
- Creative problem-solving skills.

2.3. Core skills of technical students

2.3.1. Technical communication skills

"Technical communication" is a technical term, not separate from the phrase when considering this concept. According to the Society for Technical Communication - STC (USA) technical communication includes communication forms that exhibit several characteristics: 1/Communicate on professional or technical topics; 2/Communicate using technology; 3/ Provide instructions on how to do something.

We can look at technical communication in two ways: as the process of making and sharing information and ideas in the workplace, and as a collection of applications and written documents. Technical communication is good and effective when it is precise, clear, concise, coherent, and relevant. A major part of technical communication involves the transfer of technical information [17, p.7]. Technical communication skills are defined as the narrator observed: *Technical communication skill is conveying information in technical language for analysis, synthesis, and presentation of technical object.*

Technical communication skills include component skills:

- *Technical object analysis skill:* Breaking down a technical whole into individual components and clarifying the relationship between them. Eg analyzes a technical drawing or a technical system.

- *Information organization skill:* Arranging, classifying, dividing technical problems or topics according to space or importance.

- *Technical report writing skill*: Taking notes, writing reports such as progress reports, research outlines clearly according to the report structure.

- *Technical presentation skill*: Creating a dialogue between the speaker and the listener about a technical topic. For effective technical presentations, presenters can use graphical objects to clarify presentations.

- *Technical graphic communication skill:* Performing technical graphics by hand or by computer to produce clear, detailed technical drawings with standard conventions and symbols. Objects can be represented in 2D or 3D.

2.3.2. Creative problem-solving skills

The concept of "creation" is mentioned in many studies since the beginning of the twentieth century, according to Vygotski LX (1934) Torrance PE (1990), *creativity is understood as the process of identifying hypotheses, studying, and finding results* [18, p.103]. Tran Hiep and Do Long (1990) say that: *Creativity is the activity of creating and discovering material and spiritual values. Creativity requires individuals to develop their capacity, to have incentive, knowledge, skills and with such conditions to create new, unique, and profound products* [19, p.38]. We agree on the definition of "Creative problem-solving skills" as follows: *Creative problem-solving skills are specific actions and intellectual actions applied to solving technical problems. techniques in the learning process in a new and effective way according to the sequence of steps, appropriate operations without precedent.*

Creative problem-solving skills include component skills:

- *Technical problem identification skills*: Finding out the "problem" in the problem, what is the situation we face, the scope, the legitimacy.

- *Skills in searching, processing information, and planning to solve technical problems*: Searching for information and processing information to collect enough missing data of a technical problem is a job that requires technical students to be proficient.

- *Ability to propose optimal technical solutions, new solutions:* The proposed solutions must be new and diverse. In the process of finding a solution to solve a technical problem, students must use technical thinking to analyze, synthesize, and generalize information and data.

Technical systems thinking skills

The engineering system is the structural system of the engineering object. Each engineering object is fabricated with parts and details forming a system structure. The function of an engineering system is to transform, move or store quantities: matter, energy, and information in space and time. Engineering systems thinking arises when engineering problems arise. Tasks or technical problems are very diverse, depending on the respective technical disciplines such as design and manufacturing problems, machining problems, fault finding problems, preservation problems. Engineering systems thinking is a cognitive process that reflects the properties of an engineering system such as the composition of the engineering system, the engineering principles, and the operation of the technical system that the subject does not know before. Therefore, we agree on the concept of technical systems thinking skills as: *Technical systems thinking skills are intellectual actions including analysis, synthesis, generalization, comparison to reflect the properties of the system. properties of engineering systems to solve engineering problems.*

Component skills of Technical Systems Thinking Skills include:

- *Technical system analysis skill:* The intellectual act of breaking down the engineering system into its attributes, parts, relationships, and relationships for a deeper understanding of the engineering system.

- *Technical systems synthesis skill:* The Intellectual action brings the attributes and components that have been analyzed into a technical system for broader perception.

- *Technical system generalization skill:* The Intellectual action covers many different technical systems into a group, a category on the basis that they have some common properties, nature, regular relationships.

- *Technical systems comparison skill:* The intellectual act of determining the similarities and differences between engineering systems or between attributes, relationships, and parts of an engineering system.

2.4. Building a framework to assess the core skills of engineering students

According to the level of action, K.K Platonov and G.G Goubev divided into 5 skill-level corresponding to the achievement of the action:

- *Level 1*: elementary skills. At this level, the new subject is aware of the purpose and looks for a way to act based on the previous experience, the operation is done by "trial and error".

- *Level 2*: skills are formed but incomplete. The subject has an understanding of the method of performing the action, has performed the correct technique.

- *Level 3*: skills are formed but are individual

- *Level 4*: skills at a high level, mastery

- *Level 5*: highly skilled, proficient, proficient, and creative skills.

Synthesize both cognitive and action levels, Hubert Drefus and Stuart Drefus propose a 5-stage model including: 1/Stub (Novice); 2/Introduction (Advance beginner); 3/Competence; 4/Proficient; 5/Expert [20]

Core skills are also a narrow concept of the concept of skills, so we agree on the level of core skills including 5 levels in the following table:

Table 1. Level of Core Skills

Unformed skills	- Previous knowledge, skills, and experience have little relevance with new skills. Receive instructions and descriptions according to the available procedures. Follow and depend on the instructions.
Primitive skills	- Basic knowledge, skills, and experience are relevant and helpful for learning new skills. Perform operations such as sample manipulation, become familiar with procedures and instructions.
Formed skills	- Have enough practical experience on new skills. Apply operations related to familiar situations flexibly. Take a systematic analytical approach to tasks, especially unfamiliar situations. Offer a systematic analytical approach to tasks, especially unfamiliar situations.
Proficient	- Having practical experience in skills in a variety of situations. Organize to perform skills fluently and proficiently, regardless of instructions. Be able to evaluate the entire process of skill formation and skill products.
Expert	- Having a lot of practical experience in skills, working fluently and flexibly in complex situations. Analyze new knowledge, new experiences in different situations. Regularly re-evaluate methods and practices to produce more effective results, and recognize which rules and principles always apply.

Table 2. Performance of core skills by level

Level	Point	Behavior description
Poor	**< 4**	No or very little manifestation of correct behavior
Weak	**4 – 5.4**	Can perform some operations according to instructions but still rigid, confused the execution process, there are many redundant movements. In

		the process of implementation is still awkward, waiting for the reminder of others.
Average	**5.5 – 6.9**	Initially performing the basic operations of the skill quite accurately, but there are still a few small errors, some operations are missing or there are redundant movements, lack of flexibility but still achieve efficiency certain under familiar circumstances
Fair	**7 – 8.4**	Fully and logically perform operations. Ensure basic requirements, create efficiency, and a few minor errors
Good	**8.5 - 10**	Perform operations accurately, fully, with rhythmic, unified, and flexible coordination. Creative and able to perform in new situations and still be effective.

From identifying core skill levels, we develop metrics that measure each of the core skills of engineering students. The evaluation criteria for each core skill are described in the table with 2 dimensions, the vertical lists the criteria, the horizontal describes the achieved levels of the skills arranged from low to high. This assessment criterion is applied to assess the core skills of engineering students for activities carried out in class. On the other hand, from the core skills assessment criteria, we can survey the core skills of engineering students to analyze the actual level of core skills that students have achieved.

Rating Criteria

- Technical communication skills: 5 criteria. Total points achieved by 5 levels respectively (Base on table 2). Total score: 50 points: No skills: < 20 points; Beginner: 20 - 27 points; Skilled: 27.5 – 34.5 points; Proficient: 35 - 42 points; Expert: 42.5 - 50 points

Table 3. Criteria for grading technical communication skills

	Object analysis	**Score**
Poor (<4)	Students have not yet performed this skill. Rely on the guidance of teachers	
Weak (4 – 5.4)	Students can name parts of objects, state the meaning of symbols and standards of technical objects, but there are many errors in the analysis process.	
Average (5.5 – 6.9)	Student confused a few details, stated incompletely the name and inaccurately the standards of technical objects.	
Fair (7 – 8.4)	Students can name parts of objects, state the meaning of symbols and standards of technical objects, but still have a few errors.	
Good (8.5 – 10)	Students can divide in detail and fully the components and constitutive parts of technical objects, name the parts, state the meaning of symbols and standards of technical objects.	
	Information organization	
Poor (<4)	Students who have not yet performed this skill, only imitate the teacher's instructions	
Weak (4 – 5.4)	Students can only classify some information.	
Average (5.5 – 6.9)	Students divide information, arrange, and classify inaccurately and confused.	
Fair (7 – 8.4)	Students sort information into categories, group by criteria but there are some errors.	
Good (8.5 – 10)	Students can classify information, divide information into groups according to exact criteria.	
	Write technical reports	
Poor (<4)	Students do not know how to do, how to write reports.	

Weak (4 – 5.4)	Students are still confused when manipulating the technique of writing reports and outlines.	
Average (5.5 – 6.9)	Students present information in a format that is incomplete and not in the correct order of items.	
Fair (7 – 8.4)	Students correctly operate the report writing techniques, present the items fully as required, but the presentation is not coherent.	
Good (8.5 – 10)	Students correctly manipulate the techniques of writing reports, research topics, in their formats and complete the required items. Present information coherently in a scientific structure.	
Technical graphic communication		
Poor (<4)	Students do not have this skill.	
Weak (4 – 5.4)	Student performing sketch drawing is still messy. Technical drawings still have many errors, using computer software still has many technical errors.	
Average (5.5 – 6.9)	Students perform sketch drawings not in accordance with technical requirements. Technical drawings missing some content. Confused when using the computer software	
Fair (7 – 8.4)	Students perform a sketch still sketchy not representing the idea. Technical drawings have a few errors, using computer applications to draw is not proficient	
Good (8.5 – 10)	Students performed the sketch drawings to express ideas ensure symmetry in size. Performing technical drawings accurately, easy to understand, complete content, in accordance with standards, proficiently using computer applications to draw.	
Presentation technical report		
Poor (<4)	Students do not perform seriously, confidently, and in a confrontational manner	
Weak (4 – 5.4)	Students are not well prepared, and the presentation organization still has many errors and is not fluent.	
Average (5.5 – 6.9)	Students prepare and organize the presentation confused and use very few professional software for graphics. Incomplete data. Lack of confidence when presenting.	
Fair (7 – 8.4)	Students prepare and organize presentations as required. Using graphics and data is not effective. The oral presentation is not attractive.	
Good (8.5 – 10)	Students prepare and organize the presentation attentive, presentation graphics, professional data. Concise, systematic, precise expression. Moderate volume, speed of speech, appropriate body language.	
Total		

- Creative problem-solving skills: 5 criteria. Total points achieved by 5 levels respectively (Base on table 2). Total score: 50 points: No skills: < 20 points; Beginner: 20 - 27 points; Skilled: 27.5 – 34.5 points; Proficient: 35 - 42 points; Expert: 42.5 - 50 points.

Table 4. Criteria for assessing creative problem-solving skills

Identify problems, generate ideas		**Score**
Poor (<4)	Students have not found the problem and do not understand the problem to be solved.	
Weak (4 – 5.4)	Students demonstrate a minimal understanding of the problem. Some errors are present in identifying elements or explaining their relationship.	
Average (5.5 – 6.9)	Students demonstrate a full understanding of the problem. Minor errors are possible in identifying the elements or explaining their relationship.	

Fair (7 – 8.4)	Students demonstrate a clear understanding of the problem. Accurately identify the key elements of the problem and their relationship to each other.	
Good (8.5 – 10)	Students demonstrate a thorough understanding of the subject matter. Accurately identify all the key elements of the problem and their relationship to each other.	
Search and information processing		
Poor (<4)	Students' use of the search methods are limited.	
Weak (4 – 5.4)	Students defined minimum information and tools/ formulas needed to solve problems.	
Average (5.5 – 6.9)	Students identify some additional information and the correct tools/ formulas to solve the problem.	
Fair (7 – 8.4)	Students identify most of the additional information and the correct tools/ formulas for problem-solving.	
Good (8.5 – 10)	Students identify all additional information and the correct tools/formulas to solve the problem.	
Plan to solve the problem		
Poor (<4)	Students have not found a solution, have not planned to implement it.	
Weak (4 – 5.4)	Students choose a way to solve the problem with the minimum efficiency.	
Average (5.5 – 6.9)	Students choose an appropriate problem-solving strategy that will lead to a valid solution. Calculate a possible constraint before implementation	
Fair (7 – 8.4)	Students choose an effective problem-solving strategy and explain possible risks before implementing it	
Good (8.5 – 10)	Students choose an effective problem-solving method and anticipate the most possible risks before implementing it.	
Selecting the optimal solution with novelty		
Poor (<4)	Students do not understand the problem, difficult to express opinions.	
Weak (4 – 5.4)	Student explains at least the solution to others.	
Average (5.5 – 6.9)	Students fully justify the solution to others.	
Fair (7 – 8.4)	Students masterfully explain the solution to others using data and examples to support justification.	
Good (8.5 – 10)	Students seek out new experiences/approaches and justify solutions to others skillfully and succinctly using appropriate data and examples.	
Implement the solution		
Poor (<4)	Students expect the performance of others.	
Weak (4 – 5.4)	Students implement a problem-solving strategy to achieve a logical solution.	
Average (5.5 – 6.9)	Students fully implement the problem-solving strategy to reach a valid solution.	
Fair (7 – 8.4)	Students correctly implement problem-solving strategies to achieve solutions.	
Good (8.5 – 10)	Students implement correct problem-solving strategies and valid solutions.	
Total		

- Technical system thinking skills: 4 criteria. Total points achieved by 5 respective levels (Base on table 2). Total score: 40 points: No skills: < 16 points; Beginner: 16 – 21.6 points; Skilled: 22 – 27.6 points; Proficient: 28 – 33.6 points; Expert: 34 - 40 points.

Table 5. Criteria for assessing technical systems thinking skills

Technical system analysis		**Score**
Poor (<4)	Students cannot perform the separation of technical systems.	
Weak (4 – 5.4)	Students split the technical system with many errors and inaccuracies	
Average (5.5 – 6.9)	Students split technical systems are incomplete, lacking in detail.	
Fair (7 – 8.4)	Students split the technical system is not complete, there are some errors.	
Good (8.5 – 10)	Students split into systems engineering attributes, parts, relationships, relationships between them a detailed and accurate.	
Technical system synthetic		
Poor (<4)	Students are still confused	
Weak (4 – 5.4)	Students use technical language to form a relatively complete technical system.	
Average (5.5 – 6.9)	Students use technical language that is incomplete and inaccurate.	
Fair (7 – 8.4)	Students make great efforts to use technical language but have not met the requirements.	
Good (8.5 – 10)	Students use engineering language to design a new engineering system.	
Technical system comparison		
Poor (<4)	Students have not been able to perform this task independently.	
Weak (4 – 5.4)	Students identify the similarities and differences between technical systems that are not accurate, with many errors.	
Average (5.5 – 6.9)	Students identify the similarities and differences between incomplete and flawed technical systems.	
Fair (7 – 8.4)	Students identify the similarities and differences between engineering systems that are not completely accurate, with some errors.	
Good (8.5 – 10)	Students identify the similarities and differences between engineering systems correctly.	
Technical system generalization		
Poor (<4)	Students have not been able to perform this task comprehensively.	
Weak (4 – 5.4)	Students are confused when sorting, classifying many different technical systems into a group, a kind.	
Average (5.5 – 6.9)	Students sorted, categorized many different technical systems into a group, a kind of incomplete, irrational.	
Fair (7 – 8.4)	Students sorted, classified not completely accurate and complete, but a few flaws.	
Good (8.5 – 10)	SV sorted, categorized many different technical systems into a group, a correctly and fully.	
Total		

Illustrate how to use the criteria table to assess Creative Problem-Solving skills in a specific subject. The subject "Learning skills" is a common elective subject for students of all majors. The subject equips learners with knowledge of university study methods so that students can apply training to form university study skills to apply these skills in the learning process and research.

Teachers ask students performing a learning project called "smart learning corner in the university" and the rubric to assess student in Table 6.

Table 6. Rubric assessment for Creative Problem-Solving skills in Learning skills subject

Level	Descriptions	Score
Identify problems, generate ideas		
5	Students correctly identify all the key elements of a smart learning corner. Offering unique ideas.	
4	Students correctly identify the key elements of the "smart learning corner", can give some ideas.	
3	Students have possible minor errors in identifying the elements of a smart learning corner. If teachers help students, students can think of some ideas	
2	Students demonstrate minimal understanding of the intelligent learning angle. Students just think about a problem from one point of view.	
1	Students have not found the problem and do not understand the problem to be solved. No ideas related to the problem.	
Search and information processing		
5	Students accurately identify all the information needed to design a Smart learning corner.	
4	Students correctly identify most of the information about the Smart learning corner".	
3	Students correctly identify some information about Smart learning corner.	
2	Students identify some information about Smart learning corner.	
1	Students use limited search methods.	
Selecting the optimal solution with novelty		
5	Students outline a detailed plan and demonstrate creativity in sketches.	
4	Students outline the plan relatively fully, clarifying the idea.	
3	Students outline the plan is sketchy and not clear the idea.	
2	Students have not yet outlined a detailed plan.	
1	Students have not been able to clarify their ideas and have no products.	
Implement the solution		
5	Students correctly implemented the smart learning corner model as the idea in the design draft. Present the manuscript fluently.	
4	Students build a smart learning corner model to express ideas. Present the manuscript fluently.	
3	Students build a sketchy model, presenting the draft plan is not fluent.	
2	Students imitate existing models. Presentation is confusing.	
1	Students rely on the performance of others.	
Total		

3. Conclusions

The development of a framework for assessing core skills is based on defining the structure of each skill and establishing evaluation criteria to clarify the outcome of the skills development process. The structure of technical communication skills includes 5 components, creative problem-solving skills includes 5 components and technical systems thinking skills include 4 components. These elements are described with specific indicators to clarify each skill level from low to high. The results of this research, when implemented in the assessment of students' core skills in the process of training and developing these skills, or for students to self-assess, will help lecturers and students have an objective view. about the status of students' core skill levels. The evaluation framework is built specifically, clearly will facilitate the evaluation process. Based on this, teachers and universities will take appropriate measures to improve these skills for engineering students.

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